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SDN in GÉANT: Pilots and operational considerations

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Single presentation proposal (25 minutes)

1 Introduction

GÉANT [1] has been prototyping SDN solutions, which, in the context of the Joint Research Activity 1 (JRA1) of the GN4-Phase2 project, are being put into pilot deployment. In particular, GÉANT is preparing to pilot the SDX, SDN-BoD and Transport SDN use-cases. These use-cases are driven by the need to achieve infrastructure and operational cost-efficiency and the need to support advanced applications and use-cases from the R&E community.

An SDX (Software Defined internet eXchange point) is an exchange (or distributed exchange) for interconnection of participating networks. These networks can then configure point to point layer 2 services in between their access interfaces. Currently GÉANT participates in the operation of the GÉANT Open IXP, and the development of SDX functionality. This functionality is intended to automate connections between different network access points. It should also allow easy expansion of the exchange. Layer 2 services are controlled using the ONOS application SDX L2 and have been coded by GÉANT into the ONOS controller. Furthermore, GÉANT has developed the SDX L3 ONOS application for replicating the layer 3 operation of a route-server. This allows domains to interconnect at layer 2 and peer without an intermediate BGP hop.

SDN-BoD (Bandwidth on Demand) is intended to enhance the existing GÉANT Bandwidth on Demand service with more flexible traffic engineering strategies, better network auto-discovery capabilities, new and more granular data planes and powerful network programmability. It maintains compatibility with the Network Services Interface (NSI-CS) v2 protocol [2], so supports creation of multi-domain VLAN-based L2 bandwidth guaranteed services across heterogeneous domains. SDN-BoD has also been implemented as an ONOS application.

The Transport SDN use-case is intended to provide GÉANT with SDN capabilities at the optical Layer by using Infinera's SDN implementation (known as the Open Transport Switch), combined with the PXM card (an Ethernet switch on a blade in the Infinera DTN-X DWDM equipment). In the current GÉANT infrastructure, routers are interconnected by fixed 100G circuits (IP trunks) using the DTN-X. The routers are connected in a chained architecture – each router is connected to the nearest router following the dark fiber. This chaining of routers imposes the use of more router interfaces than necessary. The use of SDN at the optical layer will enable the management the GÉANT IP trunk transmission capacity intelligently to meet the needs of elephant flows and make use of route bypass to save on router interfaces.

2 SDN pilots

For testing purposes and for initial demonstration of the features of the applications implemented in the different use-cases, a network test-bed combining physical and virtualized equipment has been established at GÉANT premises in Cambridge, UK. The test-bed is based in a heterogeneous, multivendor, set of equipment (PICA8, CORSA, Juniper, Infinera, Dell) assuring multiple levels of interconnection. It enables a scalable and flexible configuration, targeting testing application features over basic topologies as well as complex ones. The incorporation of CORSA DP2000 series equipment into this setup, with its multi-context virtualization featuring, has contributed substantially to the scalability and flexibility of this setup.

The next step after testing in the laboratory is to pilot the use-cases over GÉANT equipment deployed in PoPs around Europe. In particular, GÉANT has obtained thirteen CORSA DP2000 series switches which are being deployed in GÉANT PoPs and interconnected via Infinera optical links. This setup allows for flexible topology structure in order to verify efficient operation over multiple topology scenarios.

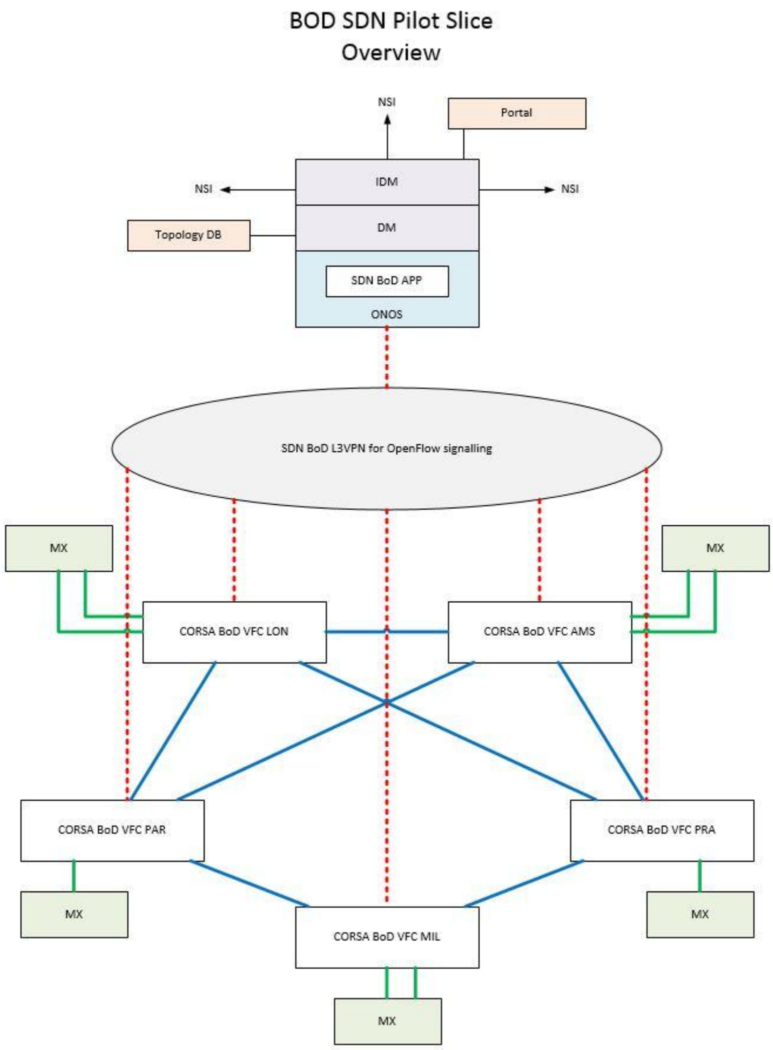

Figure 1. Sample pilot setup

The above figure presents a sample setup of the pilot for SDN-BoD, with the BoD/ONOS stack on top controlling a network of several Corsa DP2000 switches, each connected to Juniper MX routers. The pilot setup will also be further connected to other NSI domains for multidomain setups, and the trunk links between the Corsa switches are indicative as they can be changed to try different scenarios. Of the thirteen DP2000s, nine are located in the following GÉANT Points of Presence (PoPs): Amsterdam, London, Paris, Prague, Milan, Hamburg, Zagreb, Ljubljana and Madrid. In addition there are 2 in the Cambridge lab and 2 in the GTS Prague lab. The first 5 of the CORSA boxes to be deployed have 10 x 10G ports connected, others may vary depending on local requirements.

The purpose of the pilots is to demonstrate the integration of the use-cases described above in the operational environment. At this stage, the main focus is to validate the required functionality and understand the implications of deployment. In particular, a set of tests that have been carried out in the Cambridge lab will be replicated in the pilot environment.

The main purpose of the SDX use-case is to demonstrate the capability to create L2 circuits carrying either tagged or untagged traffic and to measure the scalability of the L3 BGP peering in both IPv4 and IPv6.

The pilot of the SDN-BoD use-case aims to demonstrate the ability to rate-limit flows at the level requested and agreed by the BoD service, to verify the capability of the software to discover network topology automatically and react in a timely fashion to topology changes, make efficient decisions on request admission, optimise the reallocation of flows and act effectively on network disruptions for protected services.

An important overarching objective of the pilots is to estimate the resiliency of the control plane. Because SDN brings critical functionality out of the network equipment and into software components, the SDN controller needs to be robust enough in response to various types of network, equipment and software failures. ONOS promises to deliver pioneering clustering functionality which the pilots are designed to verify. Another critical aspect that covers all use-cases is related to monitoring operations and capabilities that need to be in the SDN use-cases at least in par with the current practices.

3 Results expected for TNC

The presentation at TNC will describe the results of the pilots. We will explain the details of the pilot creation and we will report on the lessons learnt. In particular, we intend to report on the problems faced up to that point, the areas where the SDN solutions have met expectations and where they may have fallen short, in terms of functional requirements, scalability, reliability, ease of setup and operation. At the moment of writing, we have experience with operation of the applications over ONOS in the laboratory and with various types of equipment. These tests have shown that most of the functional requirements can be met, however scalability and reliability remain to a large degree unproven. As the people involved thus far have been part of the development team, ease of setup and operation could also not be objectively measured. We thus expect the pilots to shed light on these areas.

4 Conclusions

As the pilots proceed, we intend to further elaborate on the outcomes and the degree that the developed SDN solutions meet the operational criteria. We believe that only with the successful completion of pilots we will be able to convincingly answer the question of whether the SDN solutions can deliver the promised benefits while maintaining existing standards and best operation practices.

References

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